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INLAND FISHERIES

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Rome, 1997

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PREPARATION OF THIS DOCUMENT

The present guidelines have been prepared by the Fisheries Department, with the collaboration of the Legal Office of FAO, on the basis of comments and suggestions received on the draft guidelines for responsible aquaculture development, which were provided for information to the Technical Consultation on the Code of Conduct for Responsible Fishing, Rome, 26 September - 5 October 1994. In finalizing this document, due consideration was given to additional comments and suggestions received and to related expert views voiced at major international meetings and/or publications. *The document has been prepared under the coordination of R.L. Welcomme of the Inland Water Resources and Aquaculture Service, and includes additional experiences gained from other staff's work related to recent trends and developments associated with the inland fisheries sector: U. Barg, A. Bonzon, A.F.. Born, W. Edeson, R. Grainger, D. Gréboval, J. Kapetsky, C. Lería, G. Marmulla, K. Rana, H. Naeve, E. Ruckes and R. Willmann from within FAO assisted and contributed to this effort in various ways. Additional comments were provided by I. Cowx (HIFI, UK), and I. Payne (MRAG, UK).*

It has to be stressed that these guidelines have no formal legal status. They are intended to provide general advice in support of the implementation of Articles of the Code of Conduct for Responsible Fisheries pertinent to the development and management of inland fisheries. The document provides the reader with general annotations to the provisions of the Code which are meant to serve only as general guidance, and should be taken as suggestions or observations for consideration when addressing issues related to the implementation of the provisions of the Code of Conduct for Responsible Fisheries. Furthermore, any eventual differences in the terminology employed should not be understood as intending reinterpretation of the Code. It should also be remembered that since the guidelines are intended to be flexible and capable of evolving as circumstances change, or as new information becomes available, these guidelines may be further revised and complemented by other guidelines, notes, etc. on specific issues, some of which are already under elaboration. In this regard, readers are invited to collaborate with FAO providing any information on relevant technical, policy or legal issues which might be useful in updating, evaluating and improving this document as well as in developing more specific guidance documentation aiming at the promotion of responsible development and management of inland fisheries in order to contribute to sustainable food supply and to the conservation of the inland aquatic environment.

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ABSTRACT

Inland fisheries differ from most other fisheries forming the subject of the Code in their high degree of inter-relatedness with other users of the aquatic resource. In most areas of the world the principal impacts on fisheries do not originate from the fishery itself but from outside the fishery. Consequently most aspects of the Code directed at the conservation and sustainability of the resource are under the control of a wide range of interests of superior social and financial implications for society. Implementation of the provisions of the Code in these cases is more a question of negotiation and consultation with these interests. The fishery has to be managed within the constraints imposed by these external sectors and, while there is space for conventional management of the fishery as such, much attention is paid to techniques for mitigation or rehabilitation of external impacts. Inland fisheries are increasingly sharing the problems of aquaculture in that there are attempts in many fisheries to deliberately influence the composition and productivity of the fish assemblages in favour of societal goals. These introduce concepts of sustainability which correspond more to agriculture than to conventional capture fisheries and here interpretation of some articles of the Code has to be liberal.

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BACKGROUND

From ancient times, fishing has been a major source of food for humanity and a provider of employment and economic benefits to those engaged in this activity. However, with increased knowledge and the dynamic development of fisheries, it was realized that living aquatic resources, although renewable, are not infinite and need to be properly managed, if their contribution to the nutritional, economic and social well-being of the growing world's population is to be sustained.

The adoption in 1982 of the United Nations Convention on the Law of the Sea provided a new framework for the better management of marine resources. The new legal regime of the oceans gave coastal States rights and responsibilities for the management and use of fishery resources within the areas of their national jurisdiction, which embrace some 90 percent of the world's marine fisheries.

In recent years, world fisheries have become a dynamically developing sector of the food industry, and many States have striven to take advantage of their new opportunities by investing in modern fishing fleets and processing factories in response to growing international demand for fish and fishery products. It became clear, however, that many fisheries resources could not sustain an often uncontrolled increase of exploitation.

Clear signs of over-exploitation of important fish stocks, modifications of ecosystems, significant economic losses, and international conflicts on management and fish trade threatened the long-term sustainability of fisheries and the contribution of fisheries to food supply. Therefore, the Nineteenth Session of the FAO Committee on Fisheries (COFI), held in March 1991, recommended that new approaches to fisheries management embracing conservation and environmental, as well as social and economic, considerations were urgently needed. FAO was asked to develop the concept of responsible fisheries and elaborate a Code of Conduct to foster its application.

Subsequently, the Government of Mexico, in collaboration with FAO, organized an International Conference on Responsible Fishing in Cancún in May 1992. The Declaration of Cancún endorsed at that Conference was brought to the attention of the UNCED Summit in Rio de Janeiro, Brazil, in June 1992, which supported the preparation of a Code of Conduct for Responsible Fisheries. The FAO Technical Consultation on High Seas Fishing, held in September 1992, further recommended the elaboration of a Code to address the issues regarding high seas fisheries.

The One Hundred and Second Session of the FAO Council, held in November 1992, discussed the elaboration of the Code, recommending that priority be given to high seas issues and requested that proposals for the Code be presented to the 1993 session of the Committee on Fisheries.

The Twentieth Session of COFI, held in March 1993, examined in general the proposed framework and content for such a Code, including the elaboration of guidelines, and endorsed a time frame for the further elaboration of the Code. It also requested FAO to prepare, on a "fast track" basis, as part of the Code, proposals to prevent reflagging of fishing vessels

which affect conservation and management measures on the high seas. This resulted in the FAO Conference, at its Twenty-seventh Session in November 1993, adopting the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, which, according to FAO Conference Resolution 15/93, forms an integral part of the Code.

The Code was formulated so as to be interpreted and applied in conformity with the relevant rules of international law, as reflected in the United Nations Convention on the Law of the Sea, 1982, as well as with the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, 1995, and in the light of, *inter alia*, the 1992 Declaration of Cancún and the 1992 Rio Declaration on Environment and Development, in particular Chapter 17 of Agenda 21.

The development of the Code was carried out by FAO in consultation and collaboration with relevant United Nations Agencies and other international organizations, including non-governmental organizations.

The Code of Conduct consists of five introductory articles: Nature and Scope; Objectives; Relationship with Other International Instruments; Implementation, Monitoring and Updating and Special Requirements of Developing Countries. These introductory articles are followed by an article on General Principles, which precedes the six thematic articles on Fisheries Management, Fishing Operations, Aquaculture Development, Integration of Fisheries into Coastal Area Management, Post-Harvest Practices and Trade, and Fisheries Research. As already mentioned, the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas forms an integral part of the Code.

The Code is voluntary. However, certain parts of it are based on relevant rules of international law, as reflected in the United Nations Convention on the Law of the Sea of 10 December 1982. The Code also contains provisions that may be or have already been given binding effect by means of other obligatory legal instruments amongst the Parties, such as the Agreement to Promote Compliance with Conservation and Management Measures by Fishing Vessels on the High Seas, 1993.

The Twenty-eighth Session of the Conference in Resolution 4/95 adopted the Code of Conduct for Responsible Fisheries on 31 October 1995. The same Resolution requested FAO *inter alia* to elaborate appropriate technical guidelines in support of the implementation of the Code in collaboration with members and interested relevant organizations.

The Code was primarily elaborated to meet the needs of marine capture fisheries and in particular industrial fisheries. It is therefore difficult to interpret in the light of the rather different conditions pertaining in most of the world's inland waters. This document attempts to highlight these difficulties and to orient the interpretation of the various articles towards the specific needs of the inland fisheries sector.

INTRODUCTION

Fisheries in inland wáters have long provided an important source of food for mankind, however, their importance relative to other production systems has been waning over the past decades. Contributing to this diminished importance have been far reaching changes to the aquatic environment arising from human activities such as damming, navigation, wetland reclamation for agriculture, urbanization, water extraction and transfer, and waste disposal. The rising demand world-wide for water and for the services it can provide is placing pressure on all uses of this resource with a corresponding need to rationalize and intensify individual sectors while ensuring their harmonious integration. The multi-purpose nature of use patterns in inland waters creates a very distinct climate for the development and management of fisheries which, in the past century or so, become one use among many and very often one of the least significant in terms of financial yield. Management therefore should to be conducted in a climate of compromise with other users and depends as much on regulations governing their activities as those governing the fishery itself. In other words inland fishery managers are rarely in control of the resource they manage. Because of this the code must be interpreted to inform and involve sectors other than fisheries.

Four current strategies in the use of inland waters for fisheries can be distinguished.

Firstly, food fisheries on wild stocks depending on natural reproduction and fertility continue in most of the larger rivers and lakes of the world. Such fisheries are generally at or exceed the limits of maximum sustainable yield and corresponding shifts in fish community structure are occurring with risks of diminished production and damaged stocks.

Secondly, food fisheries in smaller water bodies in some countries are increasingly being subject to enhancements to raise productivity of selected species above natural levels. This type of management is spreading and the technologies are being adopted by other countries.

Thirdly, recreational fisheries are becoming more common in many areas of the world and, where they develop, tend to supplant commercial food fisheries. Recreational fisheries may contribute to food supply as in many cases they are of a subsistence or artisanal nature.

Fourthly, locally very intense exploitation of juvenile or small adult forms for stocking into other water bodies and aquaculture ponds or for the ornamental fish trade.

Each of these strategies of use requires a somewhat different approach to the code. For example, the first and fourth strategies correspond most closely to those applying in unconstrained marine fisheries in that they do not seek to manipulate the stock other than by removal of fish. Here the provisions of FAO Technical Guidelines for Responsible Fisheries **4** - Fisheries Management should be taken into consideration. Equally, strategy two approaches and sometimes overlaps with aquaculture and here the provisions of FAO Technical Guidelines for Responsible Fisheries **5** -Aquaculture Development are relevant. In general the first and fourth strategy, relying as they do on natural reproduction and productivity, can conform well to the more conservation oriented articles of the Code. However, the other two strategies more closely resemble agriculture in that they deliberately set out to manipulate the population structure and productivity of inland waters in the interests of the goals defined by society for food or recreation. In this great care has to be

taken in interpreting the Code. Further aggravating this situation are the impacts of external, non-fishery activities which in many cases constrain the fishery and add to the trend towards non-sustainability. Much of current inland fisheries management is devoted to managing of the environment in an attempt to mitigate such impacts.

While the Code of Conduct for Responsible Fisheries stipulates actions to be taken by States, it is also meant to address persons, interest groups or institutions, public or private, who are involved in, or concerned with, inland fisheries. Government authorities will increasingly have a key role to play in enhancing effective collaboration with and among many players, in order to promote sustainable development, management, conservation or rehabilitation of inland aquatic resources. Responsibilities for the sustainability of inland fisheries development will need to be shared within the sector among government authorities, fishers, processors and traders of inland fishery products, financing institutions, researchers, special interest groups, professional associations, non-governmental organizations, and others. Responsibilities must also be taken by agencies and individuals from outside the sector whose activities impact on the viability and productivity of inland water resources. In this respect inland fisheries are already subject to regulations from organizations or agencies external to the fishery concerning animal rights, land use planning, wildlife conservation, etc.

GEOGRAPHICAL LIMITATIONS

This commentary relates to the application of the code to wild and enhanced fisheries in inland waters of all continents and islands. It therefore covers fisheries in lakes, reservoirs, swamps, wetlands, rivers and their floodplains including estuaries up to the breaker line.

DEFINITIONS

The following definitions are far from exhaustive and aim at clarifying certain terms recurring in the text of the document. In particular they pertain to fisheries for human consumption and other forms of human economic activity. They do not include reference to management for specifically conservationistic objectives.

Inland fisheries: any activity conducted to extract fish and other aquatic organisms from inland waters
Capture fisheries: the removal of aquatic organisms from natural or enhanced inland waters.
Culture based fisheries: capture fisheries which are maintained by stocking with material originating from aquaculture installations.
Enhanced fisheries: (also include culture-based fisheries): activities aimed at supplementing or sustaining the recruitment of one or more aquatic organisms and raising the total production or the production of selected elements of a fishery beyond a level which is sustainable by natural processes.
Precautionary approach: a set of agreed cost-effective measures and actions, including future courses of action, which ensures prudent foresight, reduces or avoids risk to the resources, the environment, and the people, to the extent possible taking explicitly into account existing uncertainties and the potential consequences of being wrong.

Recreational fisheries: fisheries conducted by individuals primarily for sport but with a possible secondary objective of capturing fish for domestic consumption but not for onward sale.

Wild fisheries: fisheries based on natural production and recruitment.

Sustainable development: in both marine and inland fisheries, there has been a long tradition among biologists to use the term 'sustainable' with reference to the yield which can be removed from a fish stock in perpetuity. The sustainability of a fish stock is, in addition, also affected by its habitat and its interrelationship with other plant and animal species. In inland fisheries, however, with the increasing use of enhancement techniques the term sustainable takes on a more agricultural connotation implying the continuance of given levels of yield under particular regimes of input without damage to the surrounding environment. In this context a broad definition for sustainable agricultural and rural development is offered by FAO as '... the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agricultural, forestry and fishery sectors) concerns land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable, and socially acceptable.

The following sections provide commentaries on individual articles of the Code as they may be applied to inland fisheries. They draw attention to particular characteristics of inland fisheries that may differ from marine fisheries and therefore require special interpretation.

ARTICLE 6 - GENERAL PRINCIPLES

6.1 States and users of living aquatic resources should conserve aquatic ecosystems. The right to fish carries with it the obligation to do so in a responsible manner so as to ensure effective conservation and management of the living aquatic resources.

Responsibility for management Inland waters differ from most marine environments in that in that the primary responsibility for decisions affecting the environment and it living aquatic components rarely lies with the fishery authorities but with some other agency. Fisheries interests are therefore peripheral to the policy making and allocation process in most countries. The following remarks expand on the consequences of this line of responsibility for conservation and management of the fishery.

The value of aquatic ecosystems lies in the sustained net benefits derived from the many goods and services they supply including various ecological functions, products for direct and indirect human consumption, energy, aesthetic and recreational benefits, and assimilative capacity of residues of human activities. Trade-offs between the net benefits of one use *vis-à-vis* those that can be derived from other uses are usually necessary. Ideally, the preferred combination of the various uses would result in the optimization of sustained aggregate net benefits over time from the ecosystem. In practice, our understanding of complex ecosystems is insufficient to predict all present and future impacts of changes in the uses of different components of the ecosystems. As an essentially non-polluting and non-degrading activity, well managed capture fisheries do not usually subtract from the benefits which other users

can derive from inland aquatic ecosystems. On the other hand, maintaining the integrity of these fisheries may place constraints on alternative uses of the aquatic ecosystem such as the generation of energy, sinks for pollutants, and abstractions for irrigation. Frequently, fisheries have been accorded lower priority because of the perception that alternative uses contribute more to society's welfare.

Conservation of the aquatic ecosystem: Conservation of inland aquatic resources should be viewed within the multi-purpose use of river and lake basins. In most inland waters the principle constraints on the system and its living components come from human activities other than fishing. Government, at all levels from central to local authorities should set up mechanisms to conserve living aquatic resources compatible with the sustainable use of the basin, the aquatic ecosystem and the water for the whole range of economic and social purposes.

User pays principle: Users of the water and the basin should minimize any deleterious effects and contribute to the mitigation of any impacts of their activities and to rehabilitate the systems when the need for their activity has ceased. The OECD definition of the polluter pays principle is as follows:

1. The Polluter-Pays Principle constitutes for [OECD] Member countries a fundamental principle of allocating costs of pollution prevention and control measures introduced by the public authorities in Member countries;

2. The Polluter-Pays Principle, ..., means that the Polluter should bear the expenses of carrying out the measures, as specified in the previous paragraph, to ensure that the environment is in an acceptable state. In other words, the cost of these measures should be reflected in the cost of goods and services which cause pollution in production and/or consumption;

3. Uniform application of this principle, through the adoption of a common basis for Member countries' environmental policies, would encourage the rational use and the better allocation of scarce environmental resources and prevent the appearance of distortions in international trade and investment.

In principle the contribution by those damaging the resource should be total but this is rarely realizable. Government contributions to mitigation should be seen as a subsidy to the industry. Another generally undesirable form of subsidy is to allow the environment either permanently or temporarily, to bear the cost of the abuse, in which case the cost of the degraded state of the environment will be reflected in the lessened value of the aquatic system for society and a delayed bill for the rehabilitation of the system in the future.

Participation of fishers in the policy making process: Fishers or their representatives should participate in the setting of priorities for basin use representing the interests of the fishery and contributing to the mitigation of any undesirable effects of their own activities.

6.2 Fisheries management should promote the maintenance of the quality, diversity and availability of fishery resources in sufficient quantities for present and future generations in the context of food security, poverty alleviation and sustainable development. Management measures should not only ensure the conservation of target species but also of species belonging to the same ecosystem or associated with or dependent upon the target species.

The nature of inland fishery resources: Fundamental differences exist between fisheries in lakes and reservoirs compared to those in rivers. Lake fisheries tend to be more independent of short term climatic effects, to be based on a relatively small number of target species and to be located in closed systems. Rivers are highly influenced by year-to-year variations in rainfall, the fisheries are based on large numbers of species and the systems are open. Reservoirs cover a range of possibilities intermediate between rivers and lakes. Management strategies should reflect these differences.

General impacts of fishery management: It is impossible to operate a fishery without affecting the original equilibrium of the native stock of fishes. Furthermore much of modern management practice deliberately seeks to influence the composition of the fish fauna to correspond to the requirements of society by introducing new species, eliminating those that are considered undesirable and stocking with those seen as valuable.

The types of fishery: Fisheries with simple gears targeting resources with few species and stable hydrological regimes can be assessed using simple, conventional dynamics models. Regulations can therefore be based on traditional criteria such as limitations on mesh size, length at first capture, numbers of fishers, quotas etc. The multi-species, multi-gear fisheries pursued in waters with the unstable hydrological regimes characteristic of many tropical waters are not amenable to such models and require more flexible approaches, usually by limiting access, that adapt to fluctuations in the stock and the environment.

6.3 States should prevent overfishing and excess fishing capacity and should implement management measures to ensure that fishing effort is commensurate with the productive capacity of the fishery resources and their sustainable utilization. States should take measures to rehabilitate populations as far as possible and when appropriate.

Overfishing: Biologically it is relatively easy to judge the exploitation status of single species fisheries in terms of maximum sustainable or maximum economic yield. This process becomes more difficult in the case of multi-species fisheries where the same level of catch may be sustained over a wide range of effort but where characteristic changes occur in exploited fish assemblages whereby the larger species and individuals are progressively eliminated from the fishery and there is a resulting downward drift in the size of fish caught. When this happens the fact that more effort is expended to produce the same catch indicates that there is economic overfishing. The extent of rent dissipation would depend on the comparative values of the catch comprising different species of either mostly large or mostly small individuals as well as on the cost of redundant fishing effort. In artisanal and subsistence fisheries, the latter may be small because of the low opportunity cost of labour, much of it of a part-time nature, and the inexpensive nature of the fishing inputs. The change in the value of the catch may also be small as consumers shift their preferences in line with the available fish species and size classes. Therefore, rent dissipation in such circumstances

may be limited and, in any case, often costly to avoid because of the difficulty of either defining, allocating and protecting well-specified rights over the fishery resources or to limit fishing effort through administrative means. The most cost-effective management regime may often be to assign rights to groups or communities of fishers which may guarantee that some resource rent can actually be captured. With regard to biological overfishing, this can be determined using conventional models for single species fisheries. In multi-species situations overfishing can only be determined with respect to assigned target groups. Only when effort reaches such a level that there is an overall decline in catch can the assemblage as a whole be considered to be overfished. However, before reaching this stage, economic overfishing is likely to occur in the form of redundant fishing capacity and decreased net benefits.

Productive capacity: In many inland waters fisheries are enhanced with the express intention of exceeding natural carrying capacity. This may either be done by creating artificial faunas (by introductions, stocking and elimination of unwanted species), that utilize the available food resources more efficiently, through the fertilization of the water or through artificially engineering the environment to correspond better to the needs of the fish. Developers should apply such methods with caution and initially confine them to enclosed areas where there is little danger of damaging non-target ecosystems. In other areas efforts in support of endangered fish populations should be made to rehabilitate ecosystems damaged by pollution and environmental modification, by physical interventions or by systematic stocking using established protocols.

6.4 Conservation and management decisions for fisheries should be based on the best scientific evidence available, also taking into account traditional knowledge of the resources and their habitat, as well as relevant environmental, economic and social factors. States should assign priority to undertake research and data collection in order to improve scientific and technical knowledge of fisheries including their interaction with the ecosystem. In recognizing the transboundary nature of many aquatic ecosystems, States should encourage bilateral and multilateral co-operation in research, as appropriate.

Scientific evidence available: The present general state of biological knowledge of the functioning of inland aquatic systems for fisheries is more than adequate for the formulation of generalized policies for conservation and management. Because of the fragmentary and dispersed nature of inland systems knowledge of individual systems is far from complete, however. Acquiring full information on the numerous water bodies in existence would be prohibitively expensive and limnologists and fishery biologists have elaborated generalized models that are adequate for broad decision making at the capture fisheries level. As inputs into any system increase or where the impacts of a management intervention external to the fishery need to be established there will be a need to verify generalized models in the case of the individual water body or water course concerned. Knowledge of the social and economic factors regulating the fishery are generally less available because there has been a far shorter tradition of investigation into these concerns.

Drawing on traditional knowledge: One solution to the constraints imposed by the diffuse nature of the resource is to use local and traditional knowledge. Most rivers, reservoirs and lakes are fished and the fishers are well aware of the general biology of the fish species involved, their breeding seasons, migration patterns, responses to fishing methods, etc.

Equally traditional systems have been developed in many parts of the world for management of fisheries, integrating local experience and needs of various participant groups. Unfortunately, the pace of change over the past decades has destroyed many of the traditional management and knowledge systems. Efforts are needed to study and document surviving local management systems and knowledge bases so that they can be improved, adapted and applied to the changing conditions within the individual basin.

Multinational rivers, reservoirs and lakes: Many lake, reservoir and river basins lie within the jurisdiction of more than one country, or within countries more than one administrative unit. In such waters agreements should be reached for common research programmes, standardised systems of reporting, exchange of information and, where possible, common approaches to management.

6.5 States and subregional and regional fisheries management organizations should apply a precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment, taking account of the best scientific evidence available. The absence of adequate scientific information should not be used as a reason for postponing or failing to take measures to conserve target species, associated or dependent species and non-target species and their environment.

Impacts of external influences on the fishery: In inland waters, where the major impacts arise from activities outside the fishery, the precautionary approach should be extended to all developments within the basin. This means that careful impact assessments should be made of non-fishery projects. Unfortunately major damage does not always arise from a single project whose effects can be readily identified but from a series of minor interventions whose cumulative or antagonistic impacts can be enormous. It is thus relatively easy to quantify and compensate for the impact of a single large dam or irrigation project. It is much less easy to quantify and rectify the diffuse pollution caused by widescale agriculture.

6.6 Selective and environmentally safe fishing gear and practices should be further developed and applied, to the extent practicable, in order to maintain biodiversity and to conserve the population structure and aquatic ecosystems and protect fish quality. Where proper selective and environmentally safe fishing gear and practices exist, they should be recognized and accorded a priority in establishing conservation and management measures for fisheries. States and users of aquatic ecosystems should minimize waste, catch of non-target species, both fish and non-fish species, and impacts on associated or dependent species.

The nature of fishing gear: Some inland fisheries depend on a relatively small range of mesh selective gears, for example gill nets or seines. In these cases the progressive reduction in mesh size as a response to falling catches is the most common problem which can be resolve through clear setting of mesh limits accompanied by education and extension. The situation is not so clear in many other fisheries, and river fisheries in particular, which use a wide range of fishing gear adapted to the need to capture many different species and life stages of fish during very differing seasons of the year. Some of these gears are judged to be damaging by administrators and fishers, and traditional and formal administrative regulations frequently

seek to ban such methods. Fishing gears in multi-species systems are usually linked to social structure and it is difficult to ban or suppress certain gears without disturbing the balance of the society. Any decisions of prohibition of gears should therefore be based on sound biological, social and economic advice, taking into account local views, rather than a reaction to hearsay (see also 7.2.2 g) .

6.7 The harvesting, handling, processing and distribution of fish and fishery products should be carried out in a manner which will maintain the nutritional value, quality and safety of the products, reduce waste and minimize negative impacts on the environment.

Preservation of fish in inland fisheries: Inland water fisheries are characterised by numerous small craft usually undertaking short journeys from the nearest landing. In other cases the fishers migrate away from their base to remain in temporary camps for considerable periods. Because of the artisanal nature of the fishery it is rare for there to be systematic attempts to preserve the fish on shorter trips and it frequently arrives at the market in poor condition. On longer trips or in fisheries where there is a valuable product involved ice is used in some areas. Smoking and sun drying are, however, the commonest approaches although this implies considerable losses in quality and quantity of the product. The extensive use of wood for smoking has been implicated in deforestation, especially of riparian areas. It is a matter of high priority to develop improved systems for the adequate conservation especially in view of the growing lack of wood for smoking in many areas.

6.8 All critical fisheries habitats in marine and fresh water ecosystems, such as wetlands, mangroves, reefs, lagoons, nursery and spawning areas, should be protected and rehabilitated as far as possible and where necessary. Particular effort should be made to protect such habitats from destruction, degradation, pollution and other significant impacts resulting from human activities that threaten the health and viability of the fishery resources.

The conservation of the aquatic environment: Responsibility for the protection of aquatic ecosystems usually lies outside the fishery. States should, therefore, plan for the conservation of aquatic environments in the context of their multi-purpose use. Activities such as dam construction for water supply and power, channelization for navigation and flood control, land drainage and wetland reclamation for agricultural and urban use, waste disposal from urban, mining, industrial and agricultural uses, abstractions for agricultural, industrial and urban supply all have a profound impact on the aquatic ecosystem. Many of these activities are fundamental to the functioning of modern society and are economically of such importance that their limitation in the interests of conservation become hypothetical. All that can be done in many cases is to keep the number of such interventions to a minimum and to limit their impacts. Users of the aquatic system inflicting damage should contribute to the mitigation of the effects of their activities (See also 6.1).

Elements for conservation: Certain basic elements are required of an aquatic system so that it can retain its functionality.

a) The maintenance and restoration of longitudinal and lateral connectivity in rivers in the interests of conserving fish migration patterns through removal of transversal (dams) or lateral (levees) obstructions or the provision of fish pass mechanisms.

b) Restoration or maintenance of main channel diversity in rivers including meanders, point bars, bottom structure, vegetation etc.

c) Maintenance or restoration of floodplains and riverine wetlands. This does not have to be continuous along the river but provision should be made for reserves at intervals along the river where normal flood regimes are maintained.

d) Removal and control of all point-sources of pollution including industrial, urban and mining wastes. Control of diffuse pollution particularly of nutrients into lakes and rivers.

e) Control of processes at basin level particularly deforestation, mining operations in rivers and changes in agricultural practice that can lead to massive siltation which can shorten the lives of lakes and reservoirs and destabilize river channels and floodplains.

6.9 States should ensure that their fisheries interests, including the need for conservation of the resources, are taken into account in the multiple uses of the coastal zone and are integrated into coastal area management, planning and development.

See 6.8 above. The articles addressing coastal zone management (see Section 10) also apply to river basin management in inland waters. Many of the issues of conservation in rivers and lakes occur in international basins and require negotiation between states to ensure that damaging practices in states upstream are not transmitted downstream to other riparian countries.

6.10 Within their respective competences and in accordance with international law, including within the framework of subregional or regional fisheries conservation and management organizations or arrangements, States should ensure compliance with and enforcement of conservation and management measures and establish effective mechanisms, as appropriate, to monitor and control the activities of fishing vessels and fishing support vessels.

The provisions of this article apply particularly to large lakes and to river systems where there are a few large, centralized landings. More generally ensuring compliance with fishery regulations in inland waters is particularly difficult in view of the linear dispersion of the many small fisheries and landings along rivers and the diffuseness of individual fisheries on small and scattered lakes and reservoirs. The cost and practicability of surveillance by a centralised organization become prohibitive and it is usually advocated that these functions be incorporated into co-management agreements so they are undertaken by the fishery communities themselves.

6.12 States should, within their respective competences and in accordance with international law, cooperate at subregional, regional and global levels through fisheries management organizations, other international agreements or other arrangements to promote conservation and management, ensure responsible fishing and ensure effective conservation and protection of living aquatic resources throughout their range of

distribution, taking into account the need for compatible measures in areas within and beyond national jurisdiction.

International basin authorities: Most lakes, rivers and reservoirs lie within the jurisdiction of one administration. However, many major rivers and some large lakes are international. In such cases States are urged to establish international mechanisms for planning for fisheries management and aquatic conservation in the river or lake basin or to use existing basin regulatory mechanisms established for purposes other than fisheries.

6.13 States should, to the extent permitted by national laws and regulations, ensure that decision making processes are transparent and achieve timely solutions to urgent matters. States, in accordance with appropriate procedures, should facilitate consultation and the effective participation of industry, fishworkers, environmental and other interested organizations in decision making with respect to the development of laws and policies related to fisheries management, development, international lending and aid.

Allocation of the inland water resource: Given the multi-purpose nature of inland water resource management consultation and negotiation between the various parties is essential in establishing a coherent resource use policy. Such a policy should centre on the definition of clear allocation of water and the aquatic environment among users as well as a definition of the benefits and responsibilities of each in maintaining the aquatic resource in good health. In actual management regimes one or a few uses of the water tends to assume dominance and other uses have to adjust to its exigencies. This means that the other sectors are in effect involuntarily subsidising the primary use by loss of direct or indirect benefits (opportunity costs).

6.15 States should cooperate in order to prevent disputes. All disputes relating to fishing activities and practices should be resolved in a timely, peaceful and co-operative manner, in accordance with applicable international agreements or as may otherwise be agreed between the parties. Pending settlement of a dispute, the States concerned should make every effort to enter into provisional arrangements of a practical nature which should be without prejudice to the final outcome of any dispute settlement procedure.

Disputes: Most disputes in inland water fisheries derive from conflicts between the fishery and other interests such as farming, flood control and land drainage, navigation, power generation etc. Disputes can also arise among different groups of fishers one of the most fundamental of which is that between recreational and commercial fishers. However, differences also arise between subsistence and professional fishers, between resident and migrant fishers or between groups using different types of gear. In the past such conflicts have tended to have been resolved within the traditional framework of the fishing communities but as such frameworks have broken down mechanisms for conflict resolution have declined. States can contribute to the resolution of such differences by making clear regulations and decisions as to resource allocation among the various interested parties within the fishery.

In international water, disputes are likely to arise where fish migratory pathways are interrupted, ecological disturbances are transmitted from upstream, breeding sites are destroyed etc. Problems will also be experienced with regard to the cost - benefit distribution of enhanced fisheries where more than one state is involved. In such cases international agreements within the river basin framework are needed to protect all parties.

6.16 States, recognising the paramount importance to fishers and fishfarmers of understanding the conservation and management of the fishery resources on which they depend, should promote awareness of responsible fisheries through education and training. They should ensure that fishers and fishfarmers are involved in the policy formulation and implementation process, also with a view to facilitating the implementation of the Code.

Extension and training: Training and extension in inland water fisheries is universally important to allow the fishers to participate more fully in the negotiation and decision making processes that are a feature of modern inland fisheries management especially under devolved and co-management regimes. It also becomes more important as the sophistication of management increases with the adoption of enhanced systems where the cost-effectiveness of practices like stocking and fertilization become critical. Where appropriate, States should therefore establish training and extension schemes to assist fishers in making the transition from centrally administered capture fisheries to locally managed enhanced systems.

6.19 States should consider aquaculture, including culture-based fisheries, as a means to promote diversification of income and diet. In so doing, States should ensure that resources are used responsibly and adverse impacts on the environment and on local communities are minimized.

The nature of enhancements: A range of practices are deployed in inland waters to raise productivity and in particular production of selected species. These include:

- introduction of new species to exploit under-utilized parts of the food chain or habitats not colonized by the resident fauna;
- stocking natural waters to improve recruitment, bias fish assemblage structure to favoured species or maintain productive species that would not breed naturally in the system;
- fertilization to raise the general level of productivity and overall availability of food for fish thereby increasing growth and survival of the individual fish and increasing their number and biomass;
- engineering of the environment to improve levels of reproduction, shelter, food resources and vital habitat;
- elimination of unwanted species that either compete with or predate upon target species;
- constituting an artificial fauna of selected species to increase the degree of control and the yield from the system;
- modification of water bodies by cutting off bays and arms or bunding off areas, to serve for extensive and intensive fish ponds to increase control and nutrient flows;

- introduction of cage culture and parallel intensification of effort of the capture fishery;
- aquaculture through management of the whole system as a fish pond;
- genetic modification of cultured species to increase growth, production, disease resistance and thermal tolerance of the stocked or cultured material.

The balance between conservation and management: It is clear that enhancement methods of this type are deliberately aimed at changing the productivity of the water and the nature of the fish stock. As such they conflict with the conservation-oriented requirements of the Code. However, these techniques, in common with aquaculture, are aimed at increasing net incomes, as well as, secondarily, the overall supply of fish available for human consumption. As most of them require high levels of inputs of fish seed, feed, fertilizers etc. they can only be regarded as sustainable in the sense that any agricultural activity is sustainable. That is that the practice may continue from year-to-year at the same levels of input and offtake without noticeable degradation to the natural support system. Furthermore every attempt should be made to isolate the waterbodies which are subject to enhancement so that nutrient-rich effluents or escapes of stocked fish are kept to a minimum.

ARTICLE 7 - FISHERIES MANAGEMENT

7.1 General

7.1.1 States and all those engaged in fisheries management should, through an appropriate policy, legal and institutional framework, adopt measures for the long-term conservation and sustainable use of fisheries resources. Conservation and management measures, whether at local, national, subregional or regional levels, should be based on the best scientific evidence available and be designed to ensure the long-term sustainability of fishery resources at levels which promote the objective of their optimum utilization and maintain their availability for present and future generations; short-term considerations should not compromise these objectives.

See also *6.19*

Conservation and management of inland fishery resources: Current fishery management of inland waters concentrates on three components of the environment/fish/fishery system:

- Management of the fishery - regulation oriented activities concerning the activities of the fishers and their social and economic context such as licensing, control of mesh size, setting of closed seasons, control of markets, subsidies, etc. Management policies here should be aimed at: a) limiting access to the fishery so that excess effort is avoided; and b) limiting the use of destructive and harmful fishing gears (see 7.2.2)

- Management of the fish - control over the magnitude and size of the fish population by stocking, introduction of new species and other enhancement techniques as appropriate. Management here is aimed at establishing the most cost-effective approaches for enhancement.

- Management of the environment - this is pursued at two different levels: a) negotiating and arranging for adequate environmental conditions of water quality, quantity, timeliness of flow, habitat diversity etc.; and b) promoting physical improvements to improve the support capacity for fish

It is evident that of these three process the conventional management of the fishery is limited to the first of these categories.

Management of the fishery itself can be pursued in the framework of sustainability either of the resource as a whole, as in the case where a policy decision is taken to limit fishing severely in the interests of conservation, aesthetics or recreation, or with reference to particular components of the system. Decisions regarding this component of management usually are political and have been made at relatively high level by centralized fisheries agencies in the past. There is now an increasing tendency to involve local peoples in such decisions through co-management or through assignment of rights.

Management of the fish is usually pursued with the direct objective of shaping the fishery to correspond more closely to the requirement of a particular society at a particular time. It is a technical activity pursued at the level of individual fisheries dependent on individual needs. It can only take place, however, if a policy decision is taken to assign the rights to a water body where this type of management is applied so that those investing in the resource can reap the benefits of their investment.

Management of the environment is of two types: firstly interventions which seek to minimize, mitigate or restore from damaging impacts of other users. Here the decisions do not lie with the fishery managers but rather with a larger set of decision makers who implicitly or explicitly allocate the aquatic resource. Secondly, activities which seek to improve the supporting capacity of the ecosystem for fish and which form a complement to biologically-oriented systems of enhancement. Such activities do lie within the purview of the fishery managers although frequently other interests should be consulted before actions such a remeandering, re-creation of gravel bottoms or vegetation control are undertaken.

7.1.2 Within areas under national jurisdiction, States should seek to identify relevant domestic parties having a legitimate interest in the use and management of fisheries resources and establish arrangements for consulting them to gain their collaboration in achieving responsible fisheries.

Parties to inland water management: As the resource is of interest to a large number of players the consultation process should encompass a large section of society. Which elements will be drawn into such discussions will depend on the activities to be contemplated, the geographic area and the social aspirations of the various user groups. Thus, in a tropical river the major dialogue may be between the commercial fishers, the artisanal fishers and those wishing to abstract water for irrigation. In a temperate lake the discourse may be between recreational fishers, wildlife conservationists and water-sport interest groups. The important thing here is that decision makers should recognize those groups having a legitimate call on the aquatic resource and seek to involve them in the consultation process.

Where users groups (often the fishers themselves) have no organized voice, mechanisms should be set up to adequately reflect their views.

7.1.3 For transboundary fish stocks, straddling fish stocks, highly migratory fish stocks and high seas fish stocks, where these are exploited by two or more States, the States concerned, including the relevant coastal States in the case of straddling and highly migratory stocks, should co-operate to ensure effective conservation and management of the resources. This should be achieved, where appropriate, through the establishment of a bilateral, subregional or regional fisheries organization or arrangement.

Riverine and diadromous migrants: In inland fisheries the problems posed by the above categories of fish are also met with in the case of the long distance, riverine and diadromous migrants. These species are among the most valuable in a commercial sense but are among the first to disappear when the environment is heavily impacted by dam building, pollution and excessive fishing on the migratory phase. As such, in national and international inland waters alike all measures should be taken to facilitate fish movement past blocking structures such as dams and weirs, to avoid chemical barriers through localised pollution and to prohibit excessive fishing at points where the fish congregate and are especially vulnerable. Protection of migrant species should be a major concern of river basin management authorities.

7.1.4 A subregional or regional fisheries management organization or arrangement should include representatives of States in whose jurisdictions the resources occur, as well as representatives from States which have a real interest in the fisheries or the resources outside national jurisdictions. Where a subregional or regional fisheries management organization or arrangement exists and has the competence to establish conservation and management measures, those States should cooperate by becoming a member of such organization or a participant in such arrangement, and actively participate in its work.

7.1.5 A State which is not a member of a subregional or regional fisheries management organization or is not a participant in a subregional or regional fisheries management arrangement should nevertheless cooperate, in accordance with relevant international agreements and international law, in the conservation and management of the relevant fisheries resources by giving effect to any conservation and management measures adopted by such organization or arrangement.

7.1.6 Representatives from relevant organizations, both governmental and non-governmental, concerned with fisheries should be afforded the opportunity to take part in meetings of subregional and regional fisheries management organizations and arrangements as observers or otherwise, as appropriate, in accordance with the procedures of the organization or arrangement concerned. Such representatives should be given timely access to the records and reports of such meetings, subject to the procedural rules on access to them.

The role of river and lake basin authorities: The articles 7.1.4 - 7.1.6 should be taken to apply equally to river and lake basin authorities charged with the conservation and management of the resources of such basins. Where the prime objectives of such authorities is other than fisheries, for instance power generation, water allocation or navigation, protection of living aquatic resources for biodiversity and fisheries should explicitly be included in their remit. (See also section 10)

7.1.7 States should establish, within their respective competencies and capacities, effective mechanisms for fisheries monitoring, surveillance, control and enforcement to ensure compliance with their conservation and management measures, as well as those adopted by subregional or regional organizations or arrangements.

Monitoring, surveillance, control and enforcement: One of the characteristics of inland aquatic systems is their dispersion in space and time. Apart from a few major lakes and rivers, national territories usually contain many thousands of kilometres of stream, many small water bodies, marshes and swamps as well as areas such as rice fields which are used for rearing or capture of fish. The dispersion of the resource is mirrored in an equal diffusion of fishing areas and fish landings. This means that comprehensive monitoring, surveillance, control and enforcement of all inland fisheries within a national territory is frequently beyond the capacity of a State. The most economical solution to this is to charge the fishers themselves with the policing and record keeping functions of the fishery and to empower them through legal and protected rights to the resource to carry out this function.

7.1.8 States should take measures to prevent or eliminate excess fishing capacity and should ensure that levels of fishing effort are commensurate with the sustainable use of fishery resources as a means of ensuring the effectiveness of conservation and management measures.

Control of effort: Apart for a few major fisheries on large lakes and rivers, inland fisheries are generally pursued with many small artisanal units rather than single large craft. In these cases, and because of the diffuseness of the fishery and landings discussed above, it is difficult to control access to the fishery directly. For many, fishing is a part-time occupation and measures of effort are difficult to obtain. Furthermore, in rivers and fluctuating lakes the yield to be expected from the fishery may vary enormously from year-to-year. In this context absolutes are difficult to establish and most traditional management systems have developed mechanisms to deal with the variability and with the control of access. For this reason it is advisable to establish co-management or local management systems that can better deal with the local conditions. Where enhancement is adopted as a major approach to development and management of the fishery, access should be more strictly controlled and limited to those investing directly in the development of the resource. This implies some fixing of exploitation rights that may cause local inequities. Social and economic impacts of such decisions therefore should be well studied before they are adopted.

7.1.9 States and subregional or regional fisheries management organizations and arrangements should ensure transparency in the mechanisms for fisheries management and in the related decision-making process.

7.1.10 States and subregional or regional fisheries management organizations and arrangements should give due publicity to conservation and management measures and ensure that laws, regulations and other legal rules governing their implementation are effectively disseminated. The bases and purposes of such measures should be explained to users of the resource in order to facilitate their application and thus gain increased support in the implementation of such measures.

Articles 7.1.9 and 7.1.10 also apply to laws and regulations from outside the fisheries sector which may influence the fishery.

7.2 Management objectives

7.2.1 Recognizing that long-term sustainable use of fisheries resources is the overriding objective of conservation and management, States and subregional or regional fisheries management organizations and arrangements should, inter alia, adopt appropriate measures, based on the best scientific evidence available, which are designed to maintain or restore stocks at levels capable of producing maximum sustainable yield, as qualified by relevant environmental and economic factors, including the special requirements of developing countries.

Sustainability and inland ecosystems: Most inland aquatic ecosystems have already been substantially altered by the activities of man. The long historical process of dam construction, draining of marginal wetlands and straightening, deepening and encasing major channels has modified the original pristine situation of most rivers on most continents. Lakes have been less affected although eutrophication, acidification and siltation have also substantially altered their character. Further changes have arisen from species introductions. In some cases the success of introduced species resulted from physical modifications of the system which selected against native species. In other cases a mix of species suited to colonize new water bodies such as reservoirs were introduced as native species were unable to adapt to the new environments. Issues of sustainability in inland waters have, therefore, to be viewed against a background of change which has affected most waters of the world. This does not mean that sustainability is not achievable but it does mean that the baseline has changed and that very often sustainability has to be pursued against a background of new species and altered habitats. Strategies should, therefore, be based on this assumption rather than on vain attempts to restore a substantially altered ecological balance.

7.2.2 Such measures should provide inter alia that:

a) excess fishing capacity is avoided and exploitation of the stocks remains economically viable;

Measures for the conservation and sustainable management of inland fisheries can only be effective if excessive fishing effort is avoided. In order to control fishing capacity access must be controlled although technological solutions through improved enhancement practices and more environmentally friendly fishing gears can also be adopted.

b) the economic conditions under which fishing industries operate promote responsible fisheries;

Access to inland resources: Many different types of access pattern exist in inland waters. These range from outright private ownership in the case of small lakes and ponds, through communal ownership to state ownership. In many cases the inland resource is thought of as open access and fishing has often provided an occupation of last resort, especially for landless peoples. In areas liable to periodic drought inland resources may also be treated as famine crops and the resource is heavily exploited until better food supplies return. More frequently, however, access or fishing rights are determined by traditional allocation of the resource among riverain peoples. In some cases fishing rights are acquired through licenses issued by the state or purchased from the owners either directly or through auction. In systems where there is a stable system of exploitation rights assigned over long periods it is in the interest of the fishers to manage the resource sustainably. However, should the assigned period be too short, especially in fisheries where rights are acquired by auction, there is a tendency for the operator to attempt to recuperate his costs as quickly as possible by overly intensive fishing. Consequently assignment of rights either directly or through mechanisms such as auction should be for as long a period as possible.

c) the interests of fishers, including those engaged in subsistence, small-scale and artisanal fisheries, are taken into account;

Inland fisheries are essentially small-scale, subsistence or artisanal in nature. It is not unusual for small-scale commercial, artisanal and subsistence fisheries to co-exist in the same area although with some degree of conflictuality. Major impacts on fishers usually derive from outside the fisheries sector when large scale projects involving alternative uses of water can alter the whole nature of the resource. Typical of this is the need to displace communities and re-educate fishers when riverine fisheries are converted to lacustrine ones following impoundment. The impacts on and needs of fishers should be taken into account within the general impact assessments of all such projects.

d) biodiversity of aquatic habitats and ecosystems is conserved and endangered species are protected

e) depleted stocks are allowed to recover or, where appropriate, are actively restored;

Conservation of biological diversity: The comments on section 7.2.1. develop the theme that existing biological diversity in inland waters has been eroded by a large number of species introductions, by stocking programmes and by environmental changes induced by human activities. It is therefore difficult to establish criteria for future conservation efforts. Apart from a few directed attempts to rehabilitate rivers and lakes and restore historically appropriate faunas most efforts at conservation have to concentrate on maintaining the sustainability of vastly altered species assemblages in modified aquatic ecosystems. In this case the responsibility of the fisheries manager is to ensure that further degradation does not occur through additional introductions of inappropriate species, that the genetic composition of stocked fish is compatible with the native stocks and, above all, that the environment is protected from further negative impacts.

Protection of endangered species and habitats: conservation problems are not limited to endangered species but also to certain types of wetland habitat. The options for species conservation are *ex situ* whereby the threatened species are kept in aquaria or other suitable localities with the eventual objective of reintroduction to the native water when conditions permit. This strategy is particularly popular for smaller ornamental species although many larger species are held in aquaculture installations or have been introduced outside their original range for this purpose. Ideally such options should not only be adopted for species but for particularly valuable strains in order to maintain the genetic diversity of the species. *In situ* conservation implies one of three strategies. Firstly programmes of stocking the subject species into native waters where self-reproducing stocks have failed for one reason or another. Secondly through the establishment of reserves. In lakes areas may be set aside as protected locations although such reserves will only serve as protection against fishing or direct environmental interventions. They will not protect against diffuse influences such a eutrophication or the introduction of a major predator. In rivers the concept of a chain of beads pattern of reserves has been developed whereby it is deemed ecologically sufficient to allow selected areas along the river to retain their natural flood regime and floodplain morphology. Unfortunately the cumulative effects of flood control and modification in the system as a whole may place undue hydraulic stresses on such locations and solutions to this have to be sought. The third strategy, the complete rehabilitation of the system, is at present confined to smaller lakes and rivers.

f) adverse environmental impacts on the resources from human activities are assessed and, where appropriate, corrected; and

Environmental impacts: Much of current concern with inland waters revolves around various types of environmental damage. There are strong trends to try to reverse the sometimes long standing adverse impacts in more affluent temperate nations. However, the pressure to expand negatively-impacting activities such as dam building, creation of navigation channels, water abstraction for irrigation, and pollution by urban, agricultural and industrial wastes is still prevalent in developing economies. Because the short and medium-term economic benefits of such developments to the country are seen to be far superior to the maintenance of the environment and the fishery resources there is a strong temptation to give conservation of the aquatic resource relatively low priority. This may be viewed as a subsidy to development on the part of the environment. Experience has shown, however, that this debt has to be repaid as many valuable, but so far uncosted, ecosystem services disappear along with the health of the environment. States should therefore endeavour to plan forward through impact assessments and investment in mitigating measures as an integral part of development.

g) pollution, waste, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species, and impacts on associated or dependent species are minimized, through measures including, to the extent practicable, the development and use of selective, environmentally safe and cost-effective fishing gear and techniques.

Damaging fishing methods: In multi-species fisheries many fishing methods are judged by the fishers to be detrimental to the fishery as a whole or to the fish stock. In traditional fishery management systems such gears are usually banned for the whole or part of the year. With the breakdown of traditional systems of fisheries management in many parts of the world the use of such gear has remained unchecked and managers should seek to limit their use as appropriate. Certain fishing methods are universally recognized as constituting a menace to the fishery, for example fishing with explosives, poisons or electric gear, and these should be banned in all inland waters except, in certain circumstances for scientific research. Equally cross river barrier traps set for migrating fish at their areas of maximum concentration should never exceed two-thirds of the channel width to allow for a percentage of escapees.

7.2.3 States should assess the impacts of environmental factors on target stocks and species belonging to the same ecosystem or associated with or dependent upon the target stocks, and assess the relationship among the populations in the ecosystem.

See comments under 7.2.1.

7.3 Management framework and procedures

7.3.1 To be effective, fisheries management should be concerned with the whole stock unit over its entire area of distribution and take into account previously agreed management measures established and applied in the same region, all removals and the biological unity and other biological characteristics of the stock. The best scientific evidence available should be used to determine, inter alia, the area of distribution of the resource and the area through which it migrates during its life cycle.

The nature of multi-species fisheries: Fish assemblages in rivers and many lakes are highly complex. The number of species in a river or lake is strongly correlated with its basin area. As fishing effort increases characteristic and predictable changes occur in the fish assemblages which have strong implications for sustainability and management. In general as effort increases larger individuals and species disappear from the assemblage to be replaced by smaller counterparts. This means a gradual drift downwards in mean length of the target populations, towards shorter lived, faster growing species. This is accompanied by an initial increase and later a decrease in the number of species in the exploitable population although the number of fish actually appearing in the catch will increase until a certain critical level is passed. Standing stocks will decrease but total production will rise giving an increase in the ratio of production to biomass. As a result, although individual species in the assemblage may conform to standard surplus yield models, the overall catch curve rises initially to reach a plateau which is sustained over a considerable range of increasing effort. Eventually, when effort reaches sufficiently high levels the assemblage may become sufficiently impoverished as to become destabilized and collapse but more frequently economic factors limit the rise in effort and prevent this level of overfishing. Very high effort fisheries are usually the result of high population densities brought about by local economic expansions. These in themselves tend to place pressure on the resource through the pollution and environmental modification. Changes in fish assemblages subject to such stresses parallel those produced by fishing and the combined effects of fishing and environmental degradation may well be synergistic.

There are several implications for management in this process. Firstly, classical terms such as overfishing are difficult to apply. Individual species may be overfished and disappear from the fishery but the assemblage as a whole continues to produce at a high level, albeit of fish which may not have the same value as those that have disappeared. In this context overfishing can only be deemed to occur with reference to some defined value such as a particular group of species, quality, size etc. Secondly, the fishery can absorb increased amounts of effort, either as labour or as improved technology that would be supported by a fishery concentrating on only the larger species in the assemblage. These two factors mean that those responsible for managing the fishery can select either explicitly or implicitly from a range of options between aiming the fishery at only the most valuable larger species, through maximizing yield but retaining a reasonable quality of product, or to maximizing the employment (or distribution of the benefits of the fishery) by allowing the effort to rise. In reality it is not uncommon to see fisheries managed for a combination of these objectives.

7.3.2 In order to conserve and manage transboundary fish stocks, straddling fish stocks, highly migratory fish stocks and high seas fish stocks throughout their range, conservation and management measures established for such stocks in accordance with the respective competences of relevant States or, where appropriate, through subregional and regional fisheries management organizations and arrangements, should be compatible. Compatibility should be achieved in a manner consistent with the rights, competences and interests of the States concerned.

See section 7.1.3.

7.3.3 Long-term management objectives should be translated into management actions, formulated as a fishery management plan or other management framework.

Allocation of the aquatic resource: States should clearly formulate national plans for the use of water including allocation for fisheries and for the protection of the aquatic environment. Within the fisheries sector objectives should be individually set for major fisheries and fisheries management strategies developed accordingly. Smaller rivers and lakes may be grouped by regional objectives within the country. Decisions need to be taken on use - normal capture or enhanced fisheries. Target species - fisheries concentrating only on larger species, or maximum production of larger numbers of smaller species. Allocation - recreational fisheries, fisheries reserved for native peoples, open access or restricted access for commercial purposes. Etc.

7.3.4 States and, where appropriate, subregional or regional fisheries management organizations and arrangements should foster and promote international co-operation and co-ordination in all matters related to fisheries, including information gathering and exchange, fisheries research, management and development.

Basin management for shared basins: See sections 7.1.4 - 7.1.6

7.3.5 States seeking to take any action through a non-fishery organization which may affect the conservation and management measures taken by a competent subregional or regional fisheries management organization or arrangement should consult with the latter, in advance to the extent practicable, and take its views into account.

Multi-purpose management: As a multiple resource system with a heavy economic bias to non-fishery uses of the aquatic system, most management decisions regarding the development of the basin are taken by organizations outside the fisheries sector. This means that the fishery is called on to manage its resource under the constraints imposed by others. This clearly calls for full consultation with other users in an attempt to negotiate optimum conditions for fisheries interests. Increasingly, however, external constraints are not only imposed by economic interests but by conservationist and cultural groupings including animal rights and environmentalist groups. Very often the agenda of these groups contrasts with that of fisheries but on occasions their interests may coincide when there is a powerful need for conservation in the face of abuse of the environment. In such circumstances alliances should be sought with other groupings of parallel interest to form a stronger bargaining position. The concept of integrated aquatic resource management has been developed in an attempt to provide a set of tools for interested parties to jointly plan the allocation and responsibility for the management of all resources in a basin. This requires that persons who are competent and mandated to represent these interests groupings exist. In many countries such groupings either do not exist or the official recognition that would enable them to effectively participate in such discussions. States should endeavour to encourage the development of representative user groups for this purpose.

7.4 Data gathering and management advice

7.4.1 When considering the adoption of conservation and management measures, the best scientific evidence available should be taken into account in order to evaluate the current state of the fishery resources and the possible impact of the proposed measures on the resources.

Impact assessment: Systematic impact assessments should be made of all projects including proposals for change of land use, deforestation etc. which have the potential to alter the aquatic ecosystem and the fisheries that depend on it. Such assessments should equally be made of proposals for mitigation or rehabilitation projects. Impact assessments should then be taken into account when planning the overall allocation of the aquatic system between fisheries and other users. The fact that the cumulative effects of many small projects may equal or exceed that of one big one should be taken into account in considering impacts.

7.4.2 Research in support of fishery conservation and management should be promoted, including research on the resources and on the effects of climatic, environmental and socio-economic factors. The results of such research should be disseminated to interested parties.

Research: The difficulties of researching inland waters because of their diffuse and discrete nature have already been commented on in section 6.4. At the level of species and ecosystems knowledge on inland water resources is variable and patchy. Some systems, such as temperate salmonid streams, are well understood whereas in others, such as large tropical rivers the taxonomy, biology and ecology of the numerous species is very incomplete. Black box models which require only limited knowledge of the individual species involved have been used widely in fisheries management and these function well within the very general limits of their application. More detailed planning for the conservation of individual species, the rehabilitation of rivers for specific faunas or the consideration of proposals for species introductions requires more complete knowledge of the species involved. Equally, evaluation of impacts of activities such as dam construction, water abstraction, channelization etc.

presupposes knowledge of specific aspects of the biology of the fish likely to be affected including migration patterns, breeding behaviour, feeding requirements, instream flow needs etc. Research requirements are not limited to the biological disciplines as such. On the whole, the social and economic dimensions of the sector are equally poorly understood. Here more information is needed on user group performance, behaviour, interactions and allocation of benefits.

7.4.3 Studies should be promoted which provide an understanding of the costs, benefits and effects of alternative management options designed to rationalise fishing, in particular, options relating to excess fishing capacity and excessive levels of fishing effort.

Economics of inland fisheries: The economics of inland fisheries operations are generally poorly understood. The diversity within an individual fishery, the strong seasonality, the year-to-year variation of many fisheries, the fact that many fishers are part time moving between fishing and other activities, and the complexity of the diffuse marketing structures through which most inland catches are passed on to the consumer all complicate such studies. More information is needed so that more appropriate management policies be formulated with due consideration being given to allocation and distributional aspects. Two sectors in particular are attracting interest in this respect, the cost effectiveness of enhanced fisheries and the economics of recreational fishing.

The cost effectiveness of enhancements: Activities to improve fisheries have a long history and stocking in particular has become a universal management tool. These practises have, however, usually been adopted uncritically with little attempt to determine their economic effectiveness. Enhancement has now reached a level where increasing adoption of techniques such as stocking, and the increased privatization of such fisheries means that margins for waste are considerably reduced. States and other agencies involved in fisheries management should carefully evaluate the practices to reduce waste and improve their cost-effectiveness with a view to ensuring their financial sustainability.

Valuation of recreational fishery: Recreational fisheries present a special case within the set of fisheries in that practitioners do not rely on the activity for their livelihood and that many of the terms in calculating their value lie outside the fishery itself. Recreational fishers are usually prepared to spend considerable sums of money on their sport not only in licenses for access to the fishery but for gear, transport and accommodation. Groups of resource owners, professional assistants, boat owners, etc. may depend on the recreational fishery for their livelyhood and the recreational fishery may thus contribute significantly to local economies through its employment potential. In this way the product of the fishery in terms of fish is only of small significance and other aspects of the fishery such as aesthetic enjoyment and local economics become more important. There are several methods to assess the economic value of goods and services supplied by nature in the absence of a market. Whereas a market, and thus price, usually exists for food fish, the recreational value of the fishery resource may need to be assessed through non-market valuation techniques which indirectly or directly attempt to measure the users' willingness-to-pay. For example, based on expenditures and travel behaviour (travel-cost valuation method), it has often been found that the willingness-to-pay for the fishery resource by recreational fishers is higher by an order of magnitude than its value based on the market price of food fish. Production cost estimates may also be of value in that the cost of material for stocking may often exceed that which can be economically supported by a food fishery. These comparisons, however, are not without

problems, especially in many developing countries where on the one hand, the market price of food fish may only inaccurately reflect real food fish demand because many consumers may be unable to indicate their willingness-to-pay in the market due to poverty and, on the other, where a greatly unequal income distribution 'inflates' the expenditures which some sections of the society can incur for recreational purposes. Whatever the context, however, recreational fisheries, where they become established, tend to drive out purely food fisheries because of their apparent greater value and the greater political influence of the recreational fishery lobby.

7.4.4 States should ensure that timely, complete and reliable statistics on catch and fishing effort are collected and maintained in accordance with applicable international standards and practices and in sufficient detail to allow sound statistical analysis. Such data should be updated regularly and verified through an appropriate system. States should compile and disseminate such data in a manner consistent with any applicable confidentiality requirements.

Inland fisheries statistics: The number and dispersion of lakes, reservoirs and rivers within the territory of any nation is such that it is difficult to set up adequate sampling systems to cover the whole of the resource, nor is it generally economic to establish expensive sampling stations on numerous small water bodies which have little individual production. Two major solutions to this have been adopted. Firstly to have official concern only for the most significant landing sites on the largest rivers and lakes. This technique tends to ignore a substantial part of the national resource because, although the individual yields from small rivers and lakes may be insignificant the cumulative contribution to national catches may be high. Secondly, to base statistical collection on a weighted sampling frame which aims at being representative for the country as a whole and thirdly, to increasingly rely on fisherman's groups to participate in the collection and reporting of fishery data.

Essential components of statistical analysis: the temptation to be overly comprehensive in data collection should be avoided and certain basic parameters should be selected as the basis for statistical programmes. These may vary according to the type of fishery. For instance, in a simple capture fishery data on effort, catch, length analysis and species composition should be enough to characterise the fishery. In enhanced fisheries more detailed information on input and rates of return will be needed. The measures for recreational fisheries may differ depending on whether the catch is consumed, removed or returned. They should also include such factors as angler satisfaction which do not figure in the more general statistics. In any case recreational fishers as a whole are more willing to collaborate in gathering information which may improve their sport and the obligation to report is often included in the license.

7.4.5 In order to ensure sustainable management of fisheries and to enable social and economic objectives to be achieved, sufficient knowledge of social, economic and institutional factors should be developed through data gathering, analysis and research.

Studies on the social component of the fishery: See also remarks under section 7.4.3. Remarks on the knowledge of the economics of inland fisheries also apply to social issues as the two factors are usually highly related. In the past many fisheries were regulated by tradition through established hierarchies of responsibility. Many such systems disappeared or became degraded because traditional rights remained unprotected and uncodified. As a consequence, the entry of new commercial and recreational users created quasi open access

which impaired the benefits which the traditional artisanal fishers would normally have obtained from their fishery. Knowledge of the functioning of such systems is important as attempts to re-establish co-management systems rely to a large measure on re-establishing similar mechanisms. Of particular importance in social studies are the mechanisms whereby societies adapt to shifts in management strategy within multi-gear multi-community fisheries, to changes in overall use patterns particularly the conversion of rivers to reservoirs following damming, to changes in ownership and access patterns within fishery enhancement programmes etc.

7.4.6 States should compile fishery-related and other supporting scientific data relating to fish stocks covered by subregional or regional fisheries management organizations or arrangements in an internationally agreed format and provide them in a timely manner to the organization or arrangement. In cases of stocks which occur in the jurisdiction of more than one State and for which there is no such organization or arrangement, the States concerned should agree on a mechanism for co-operation to compile and exchange such data.

7.4.7 Subregional or regional fisheries management organizations or arrangements should compile data and make them available, in a manner consistent with any applicable confidentiality requirements, in a timely manner and in an agreed format to all members of these organizations and other interested parties in accordance with agreed procedures.

Regional fishery statistics: While most inland rivers and lakes lie within the confines of one state many major lakes and rivers are international in that their waters lie within more than one national territory. Collection of statistics and data has normally been regarded a national concern except in a few international water bodies where a competent basin authority exists. Problems of consistency of reporting and interpretation have therefore become a problem. The need for more unified approaches to inland fisheries conservation and management, especially in international rivers and lakes has given rise to a degree of synthesis which has formulated general principles of system function but the application of these principles to individual systems remains to be generalized. Added to this, there is at present no separate reporting of inland production in the national statistics of many countries which means that it difficult to estimate the global or regional contribution of fish from natural inland systems to global fish production, to analyse the contribution of different production systems to the production and to detect trends in resource use. The improvement of collection and reporting of inland catch statistics and related information and the harmonization of methods for doing so is therefore high priority in many areas.

7.5 Precautionary approach

7.5.1 States should apply the precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment. The absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures.

Application of the precautionary approach: While the precautionary approach should be applied to fisheries development especially when contemplating the introduction of enhanced management systems there is an equal need to apply the approach to non-fisheries sectors whose capacity to damage the ecosystem is usually much greater than that of the fisheries themselves. The approach should also be applied within the socio-economic frame seeking to

avoid introduction of new or exaggerate existing social inequities. A typical example of the precautionary approach is that advocated by the Framework for the responsible Use of Introduced Species (FAO Fisheries Report 541 suppl., 1997) (see also 3. P.16 of FAO Technical Guidelines for Responsible Fisheries 5 - Aquaculture Development)

7.5.2 In implementing the precautionary approach, States should take into account, inter alia, uncertainties relating to the size and productivity of the stocks, reference points, stock condition in relation to such reference points, levels and distribution of fishing mortality and the impact of fishing activities, including discards, on non-target and associated or dependent species, as well as environmental and socio-economic conditions.

7.5.3 States and subregional or regional fisheries management organizations and arrangements should, on the basis of the best scientific evidence available, inter alia, determine:

a) stock specific target reference points, and, at the same time, the action to be taken if they are exceeded; and
b) stock-specific limit reference points, and, at the same time, the action to be taken if they are exceeded; when a limit reference point is approached, measures should be taken to ensure that it will not be exceeded.

Reference points in inland fisheries: The multi-specific nature of many inland fisheries implies the use of reference points derived from some emergent parameter of the fish assemblage in combination with the management criteria selected for that particular assemblage (See article 7.3.1). Within multi-species assemblages such reference points may be the age structure of the catch, the mean length of the fish caught, the relative composition of trophic types, or the presence or absence of key species. At present there is insufficient information to establish such reference points for most systems at any but the most generalized level nor is there much information on the resilience of such fisheries when subject to significant changes in species composition induced by excess effort. It is known that fish populations in fluctuating river systems are very resilient and able to sustain considerable stress from fishing and climatic variations but such resilience should not be assumed for all systems.

7.5.4 In the case of new or exploratory fisheries, States should adopt as soon as possible cautious conservation and management measures, including, inter alia, catch limits and effort limits. Such measures should remain in force until there are sufficient data to allow assessment of the impact of the fisheries on the long-term sustainability of the stocks, whereupon conservation and management measures based on that assessment should be implemented. The latter measures should, if appropriate, allow for the gradual development of the fisheries.

The provision of the approach is particularly applicable to development of enhanced fisheries where permanent changes can be produced in the target system both ecologically and socio-economically. Widespread introduction of enhancement techniques should be preceded by a pilot phase in a self-contained water body.

7.5.5 If a natural phenomenon has a significant adverse impact on the status of living aquatic resources, States should adopt conservation and management measures on an

emergency basis to ensure that fishing activity does not exacerbate such adverse impact. States should also adopt such measures on an emergency basis where fishing activity presents a serious threat to the sustainability of such resources. Measures taken on an emergency basis should be temporary and should be based on the best scientific evidence available.

Influence of natural climatic variability: Inland fisheries are particularly susceptible to natural climatic variations. Large rivers, many lakes and swamps all respond to intra- and inter-annual variation in rainfall. Normally the fish species and assemblages inhabiting such systems have evolved mechanisms to deal with these fluctuation and the greater stress for such systems often arises when the variability is suppressed. However, despite the natural resilience the addition of further stresses at critical times such as during severe droughts may exceed the capacity of certain species or communities to resist and emergency limitations on access, certain types of gear or certain seasons may be contemplated at such times.

7.6 Management measures

7.6.1 States should ensure that the level of fishing permitted is commensurate with the state of fisheries resources.

See article 7.3.1

7.6.2 States should adopt measures to ensure that no vessel be allowed to fish unless so authorized, in a manner consistent with international law for the high seas or in conformity with national legislation within areas of national jurisdiction.

7.6.3 Where excess fishing capacity exists, mechanisms should be established to reduce capacity to levels commensurate with the sustainable use of fisheries resources so as to ensure that fishers operate under economic conditions that promote responsible fisheries. Such mechanisms should include monitoring the capacity of fishing fleets.

The basic fishing unit: The major fishing unit in inland waters centres around the fishers who is the licence holder in most fisheries and who is assigned rights either by Government or by acquisition through auction in others. Except in a few major fisheries, such as the Amazon, fishing vessels are small and fishing is often carried out from structures other than boats such as the shore, barrier traps or fixed rafts. Control of effort in inland fisheries is best achieved through the establishment of clear access rights among inland water fishers and fishing communities and the setting up of appropriate mechanisms for ensuring that such access is respected.

7.6.4 The performance of all existing fishing gear, methods and practices should be examined and measures taken to ensure that fishing gear, methods and practices which are not consistent with responsible fishing are phased out and replaced with more acceptable alternatives. In this process, particular attention should be given to the impact of such measures on fishing communities, including their ability to exploit the resource.

Value of multi-gear fisheries: Inland fisheries, especially in rivers and swamps, generally use a wide range of gear (see article 6.6) which enables the fishery as a whole to respond to changing conditions throughout the yearly cycle. Different types of gear are associated with different sections of the fishing community and many inland fisheries consist of complex associations of sub-fisheries. In this respect efforts have to be made to rationalize the use of gear by banning the most damaging - (see article 7.2.2 section (g)) - while at the same time conserving social equity. Particular attention should be paid to specialist fisheries which have a potential to damage resources, such as the fisheries for fry for stocking or those for small ornamental species.

7.6.5 States and fisheries management organizations and arrangements should regulate fishing in such a way as to avoid the risk of conflict among fishers using different vessels, gear and fishing methods.

Conflicts between recreational and food fisheries: Substantial conflicts exist between various objectives for managing of inland fisheries. A major difference in resource allocation is between recreational and food fisheries. Because the recreational fishery is generally worth more than the food fishery and because of the lack of secure rights on the part of the food fishers there is a tendency for recreational interests to drive out artisanal and even subsistence fisheries even in countries with food deficits. This phenomenon used to be confined to the affluent temperate regions but is increasing even in less affluent tropical regions.

Conflicts within food fisheries: Fisheries in inland waters are technically and socially complex. The wide variety of gears current in rivers and in many lakes have been developed to catch a wide variety of species and life stages and to be used in different localities and seasons. These various types of gear are usually confined to distinct groups of fishers with the most affluent using the most effective, costly and sophisticated, such as large barrier traps, beach seines or brush parks. Poorer fishers are usually confined to simpler gears such as dip nets, hooks and simple traps. The various categories of fishers may be organized into a harmonious social hierarchy but in other areas they are in direct competition. Care has to be taken in defining fishing policies so that social equity is maintained and that the poorer fishers are not victimized by gear restrictions.

7.6.6 When deciding on the use, conservation and management of fisheries resources, due recognition should be given, as appropriate, in accordance with national laws and regulations, to the traditional practices, needs and interests of indigenous people and local fishing communities which are highly dependent on fishery resources for their livelihood

Role of indigenous peoples in inland fisheries: Fishing is one of the major activities of local peoples in many areas of the world and has been retained in many areas through long standing traditions. In other areas where indigenous peoples are in reserves they hold the sole rights of access to the fishery. In other areas, particularly where impacts of major dams have eliminated runs of anadromous species, stocking and rehabilitation have been programmed to provide for continuity of the resource.

7.6.7 . In the evaluation of alternative conservation and management measures, their cost-effectiveness and social impact should be considered.

7.6.8 The efficacy of conservation and management measures and their possible interactions should be kept under continuous review. Such measures should, as appropriate, be revised or abolished in the light of new information.

7.6.9 States should take appropriate measures to minimize waste, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species, and negative impacts on associated or dependent species, in particular endangered species. Where appropriate, such measures may include technical measures related to fish size, mesh size or gear, discards, closed seasons and areas and zones reserved for selected fisheries, particularly artisanal fisheries. Such measures should be applied, where appropriate, to protect juveniles and spawners. States and subregional or regional fisheries management organizations and arrangements should promote, to the extent practicable, the development and use of selective, environmentally safe and cost effective gear and techniques.

7.6.10 States and subregional and regional fisheries management organizations and arrangements, in the framework of their respective competences, should introduce measures for depleted resources and those resources threatened with depletion that facilitate the sustained recovery of such stocks. They should make every effort to ensure that resources and habitats critical to the well-being of such resources which have been adversely affected by fishing or other human activities are restored.

Mitigation: Where there are impacts by a non-fishery user which will continue mitigation can only be within the constraints imposed by that use. Repeated inputs are usually to work against the destructive trend of the imposed use. As such, mitigation is of itself rarely sustainable but may contribute to the sustainability of the stock as a whole. Stocks of individual species or groups of species which are either endangered by environmental change or are overfished can be maintained by:

i) attempting to rectify the element in the environment that is limiting such as lack of spawning substrate, interruption of migratory pathways or lack of critical flows;

ii) appropriate stocking programmes;

iii) construction of effluent treatment plants to ensure adequate water quality.

Alternatively, other species may be introduced to the system which are more suited to the altered conditions as in reservoirs in basins where no suitable lacustrine elements exist in the native fauna.

Rehabilitation: Where pressures from other users are eased there may be a possibility to restore natural or quasi-natural features to the river. In contrast to the sustained inputs generally required for mitigation, rehabilitation requires a one off investment after which natural processes should maintain the system. Of course in most rivers, regulation and modification will persist elsewhere in the system and thus fully natural regimes will not re-establish. This is particularly true of erosion-deposition processes and it may always be necessary to intervene with such operations as dredging to dispose of material which the

modified flow regimes cannot handle. Rehabilitation aims mainly to restore the system to as near pristine conditions as possible through -

Abiotically

i) restoration of channel diversity;
ii) restoration of longitudinal connectivity and
iii) restoration of lateral connectivity.

Biotically

i) stocking
ii) biomanipulation

Restoration of channel diversity

Channels of rivers have tended to be straightened and revetted in the interests of stable navigation and for the most rapid downstream transport of water. Such regulated environments lose species diversity and overall productivity as well as being aesthetically unappealing. Several steps are available for channel restoration for fish:

- improvement of in-channel diversity through installation of boulders, low weirs and deflectors;
- improvement of streamside cover though use of vegetation or artificial structures;
- reduction of slope of levees or confining embankments;
- reinstatement of pool-riffle sequences in low order streams;
- construction of shallow bays connected to main channel;
- set back levees to create multi-stage channels;
- remeander stream within confines of setback;
- creation of point bars, islands and gravel banks.

Each of these successive steps is aimed at increasing the diversity of the main channel. This produces a corresponding diversification of the fish as a greater range of shelter, breeding and feeding habitats become available for the different species and life stages. Apart from their value to fish a number of other environmental services are provided by rehabilitation of this type. It has been shown, for example, that the leakage of nutrients from agricultural activities in the catchment can be substantially reduced by the presence of a vegetated buffer strip along the riparian zone.

Restoration of longitudinal connectivity

One of the major problems with river regulation is the ease with which longitudinal migratory patterns can be disrupted. Even relatively low dams and weirs will form insurmountable barriers to non-salmonid species. The interruption of migratory pathways clearly impacts most severely on obligate migrants which have to move upstream or downstream to breed. It can also affect the stock structure of more static populations where genetic mixing is no longer possible and local stocks diminished by overfishing or disease can no longer be replenished from elsewhere in the system.

The most obvious method to improve fish passage over obstacles such as weirs and dams is to remove the structure. However this usually leaves a head of water to be dissipated which is often excessive for fish passage. Furthermore the high flows involved with large differences in water level accelerate erosion and affect lateral land through lowering of the water level. Four main approaches are adopted to allow fish to pass obstructions while at the same time avoiding these problems by lengthening the channel through which the head is dissipated. These are:

- fish slopes and rock ramps;
- pool and Denil type fishways;
- bypass channels and biocanals;
- fishlifts and locks.

Restoration of lateral connectivity

Separation of lateral floodplains from the main channel may occur through deliberate construction of bunds or levees for channel training for navigation, and land reclamation for agricultural or urban development. Isolation of the floodplain can also occur incidentally when flood pulses are diminished by dams constructed upstream and when the channel bed is eroded in response to lessened silt loads. Restoration, particularly of limnophilic and phytophilic species in the river depends on the reconnection of the floodplain to the channel. Floodplain restoration projects of this type are relatively uncommon due to their extensive nature and to the costs involved. Essentially, however, most proposals call for the destruction of artificial river training structures such as levees. The full original extent of flooding can rarely be reintroduced particularly in very flat floodplains and here replacement levees will be required set back sufficiently far from the channel as to allow adequate flooding. Other approaches include the installation of submerged weirs across eroded channels, flood retention structures across the floodplain to divert water into abandoned channels and lagoons, and the incorporation of new features such as gravel pits into the system.

7.7 Implementation

7.7.1 States should ensure that an effective legal and administrative framework at the local and national level, as appropriate, is established for fisheries resource conservation and fisheries management.

7.7.2 States should ensure that laws and regulations provide for sanctions applicable in respect of violations which are adequate in severity to be effective, including sanctions which allow for the refusal, withdrawal or suspension of authorizations to fish in the event of non-compliance with conservation and management measures in force.

Whilst it is important to institute sanctions within the fishery sector to ensure adherence to agreed policies and agreements, the major impacts on the inland resource arise, as we have seen, from outside the fisheries sector. Because of this it is important that systems of sanctions exist that are of sufficient weight to ensure compliance of polluting and impacting users throughout the basin as a whole.

7.7.3 States, in conformity with their national laws, should implement effective fisheries monitoring, control, surveillance and law enforcement measures including, where appropriate, observer programmes, inspection schemes and vessel monitoring systems. Such measures should be promoted and, where appropriate, implemented by subregional or regional fisheries management organizations and arrangements in accordance with procedures agreed by such organizations or arrangements.

7.7.4 States and subregional or regional fisheries management organizations and arrangements, as appropriate, should agree on the means by which the activities of such organizations and arrangements will be financed, bearing in mind, inter alia, the relative benefits derived from the fishery and the differing capacities of countries to provide financial and other contributions. Where appropriate, and when possible, such organizations and arrangements should aim to recover the costs of fisheries conservation, management and research.

Support to river basin organizations: The provision of funding to river basin authorities to enable them to pursue a fisheries agenda is particularly important. Many of the other activities can be sufficiently financed by the comparatively rich sectors they represent whereas fisheries is insufficiently funded to ensure adequate representation. Because of this many attempts to incorporate fisheries into river basin commissions have failed.

7.7.5 States which are members of or participants in subregional or regional fisheries management organizations or arrangements should implement internationally agreed measures adopted in the framework of such organizations or arrangements and consistent with international law to deter the activities of vessels flying the flag of non-members or non-participants which engage in activities which undermine the effectiveness of conservation and management measures established by such organizations or arrangements.

7.8 Financial institutions

7.8.1 Without prejudice to relevant international agreements, States should encourage banks and financial institutions not to require, as a condition of a loan or mortgage, fishing vessels or fishing support vessels to be flagged in a jurisdiction other than that of the State of beneficial ownership where such a requirement would have the effect of increasing the likelihood of non-compliance with international conservation and management measures.

Financing for inland fisheries: Inland fishers have often limited or no access to the formal credit market (banks) because of their lack of assets acceptable as collateral, and the small-scale and often remoteness of their operations. In these circumstances, they often need to rely exclusively on the financial services of middlemen who may face limited competition and can charge high interest rates. Governments should consider improving the access of inland fishers to the formal credit market through, for example, micro-credit schemes in line with the Grameen Bank concept of Bangladesh.

Funding other users of the aquatic resource: Funding may also be desirable to extend financial incentives for ecologically friendly behaviour by industry, agriculture, and other

sectors in their use of inland aquatic resources. Subsidies for investment in waste treatment plants, fish ladders, etc. may be justified in certain situations where the strict application of the polluter-pays principle is impractical or, as may be the case in poor countries, may undermine the industry's competitiveness.

ARTICLE 9 - AQUACULTURE DEVELOPMENT

Further remarks relevant to inland fisheries and especially culture-based and other forms of enhanced fishery are to be found in Article 9 Aquaculture development of the code and in FAO Technical Guidelines for Responsible Fisheries 5 - AQUACULTURE DEVELOPMENT

ARTICLE 10 - INTEGRATION OF FISHERIES INTO COASTAL AREA MANAGEMENT

In its original formulation the Code considered only coastal area management as exemplifying the problems of complex multi-use interaction in an aquatic resource. Similar problems arise in inland waters within river and lake basins where the need to compatibilize complex user systems is a fundamental part of landscape management. The following articles originally appeared in the Code as Article 10 - INTEGRATION OF FISHERIES INTO COASTAL BASIN MANAGEMENT. They have been reformulated here to underline their relevance also to basin management in terrestrial aquatic resources. In fact there is a growing body of opinion that the problems of multiple resource use in the coastal areas should be linked to that of river basins through the marine basin concept.

Further commentaries on these articles are to be found in FAO Technical Guidelines for Responsible Fisheries 3 - INTEGRATION OF FISHERIES INTO COASTAL AREA MANAGEMENT

See also Articles 7.1.4 and 7.1.6.

10.1 Institutional framework

10.1.1 States should ensure that an appropriate policy, legal and institutional framework is adopted to achieve the sustainable and integrated use of the resources, taking into account the fragility of riverine and lacustrine ecosystems and the finite nature of their natural resources and the needs of human communities residing within the basin.

10.1.2 In view of the multiple uses of inland waters, States should ensure that representatives of the fisheries sector and fishing communities are consulted in the decision-making processes and involved in other activities related to river and lake basin management planning and development.

10.1.3 States should develop, as appropriate, institutional and legal frameworks in order to determine the possible uses of inland resources and to govern access to them taking

into account the rights of riparian fishing communities and their customary practices to the extent compatible with sustainable development.

10.1.4 States should facilitate the adoption of fisheries practices that avoid conflict among fisheries resources users and between them and other users of the river or lake basin..

10.1.5 States should promote the establishment of procedures and mechanisms at the appropriate administrative level to settle conflicts which arise within the fisheries sector and between fisheries resource users and other users of the river or lake basin.

10.2 Policy measures

10.2.1 States should promote the creation of public awareness of the need for the protection and management of riverine and lacustrine resources and the participation in the management process by those affected.

10.2.2 In order to assist decision-making on the allocation and use of the resources of river and lake basins, States should promote the assessment of their respective value taking into account economic, social and cultural factors.

10.2.3 In setting policies for the management of river and lake basins, States should take due account of the risks and uncertainties involved.

10.2.4 States, in accordance with their capacities, should establish or promote the establishment of systems to monitor riverine and lacustrine environments as part of the basin management process using physical, chemical, biological, economic and social parameters.

10.2.5 States should promote multidisciplinary research in support of river and lake basin management, in particular on its environmental, biological, economic, social, legal and institutional aspects.

10.3 Regional co-operation

10.3.1 States sharing a river or lake basin should cooperate with one another to facilitate the sustainable use of the resources and the conservation of the environment.

10.3.2 In the case of activities that may have an adverse transboundary environmental effect in rivers and lakes, States should:

a) provide timely information and, if possible, prior notification to potentially affected States:
b) consult with those States as early as possible.

10.3.3 States should cooperate at the subregional and regional level in order to improve river and lake basin management.

10.4 Implementation

10.4.1 States should establish mechanisms for co-operation and co-ordination among national authorities involved in planning, development, conservation and management of river and lake basins.

10.4.2 States should ensure that the authority or authorities representing the fisheries sector in the river or lake basin management process have the appropriate technical capacities and financial resources.

Inland fisheries differ from most other fisheries forming the subject of the Code of Conduct for Responsible Fisheries in their high degree of interrelatedness with other users of the aquatic resources. In most areas of the world the principal impacts on fisheries do not originate from the fishery itself but from outside the fishery. Consequently most aspects of the code directed at the conservation and sustainability of the resource are under the control of a wide range of interests of superior social and financial implications for society. Implementation of the provisions of the code in these cases is more a question of negotiation and consultation with these interests. The fishery has to be managed within the constraints imposed by these external sectors, and although there is space for conventional management of the fishery, much attention is paid to techniques for mitigation or rehabilitation of external impacts. Inland fisheries are increasingly sharing the problems of aquaculture in that there are attempts in many fisheries to influence deliberately the composition and productivity of the fish assemblages in favour of societal goals. These introduce concepts of sustainability which correspond more to agriculture than to conventional capture fisheries, and here interpretation of some articles of the code has to be liberal.

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